Available online at http://www.journalijdr.com

IJDR

ISSN: 2230-9926

International Journal of Development Research

Vol. 07, Issue, 09, pp.15296-15299, September, 2017

ORIGINAL RESEARCH ARTICLE OPEN ACCESS

MANIFESTATION OF SYNODICAL PERIODS OF THE JUPITER AND MARS IN THE PARAMETERS OF SPACE WEATHER

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ARTICLE INFO

Article History:

Received 22nd June, 2017
Received in revised form
18th July, 2017
Accepted 20th August, 2017
Published online 29th September, 2017

Keywords:

Jupiter, Mars, Synodical periods, Yakutsk, The solar wind speed, Temperature, Precipitation.

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ABSTRACT

The influence of the Jupiter and Mars, differing considerably from each other, on the solar activity is investigated. It is shown that they change the concentration of solar wind particles by 6.27 and 8.53 percent, respectively. Average values of effects in the temperature and solar wind speed in percentage are 1.97, 0.71 and 9.05, 2.42, respectively. The power spectrums as a function of periods with respect to the Wolf's numbers show the noticeable effects corresponding to the periods of 399 and 780 days, which were considerably greater of 27 variations. The analysis of data on the temperature and precipitation has revealed that their oscillations differ from the average values by (10.2-15.30) and (5.7-8.5).

Citation: Timofeev, V.E. 2017. "Manifestation of synodical periods of the Jupiter and mars in the parameters of space weather", *International Journal of Development Research*, 7, (09), 15296-15299.

INTRODUCTION

Solar activity (SA) is defined only by internal processes in the bowels of the Sun. But various external exposures, many of which are not yet studied, can have an effect on SA. This work is a continuation of a number of authors' researches on a modulation by external exposures of SA and, as consequences, their influence on solar and meteorological parameters. Many principles of this work were published during a number of years in journals and conference proceedings, for example [Samsonov, *et al*., 2004, Skryabin, *et al*., 2005, Timofeev, *et al*., 2007]. The proposed theme is not new. It is an addition to the themes on the SA known already. Thus, in the last century early studies of the influence of planets on the solar activity (SA) [Pudovkin, *et al*. 1977] were carried out in Russia. During that period of time for the first time the researchers found out a sufficiently pronounced relationship between the SA and location of planets experimentally. It was manifested in the form of SA anisotropy in the distribution by solar longitudes. At that time that effect was absolutely new. It experimentally demonstrated that SA was subjected to the sufficiently noticeable external influence, at least, from planets. Approximately at that period there appeared the first theoretical models for the explanation of this phenomenon [Miroshnichenko, 1985]. Already in the first project the researchers made the first attempt to explain this phenomenon at the expense of direct gravitational influence of the planets. The researchers showed that such influence was not possible. The effect in the form of tidal wave on the Sun can reach the heights of not more than 4 mm, even from all planets built in the form of « the parade». At that it was already known the Sun undergoes radial oscillations which form a wave of height of approximately 10 km on the large areas [Kotov, Severny, Tsap, 1985] and it was not manifested in the changes of SA at all. And therefore, it was hardly probable that 4 mm, which were less than usual radial oscillations of the Sun by a factor of millions , could change the SA.Furthermore, by that time it was known, that , for example, spot-formed processes took place at depths of 0.25 - 0.3 radii of the Sun. Such depths are simply inaccessible for a direct gravitational exposure by the solar system planets. Whatever a tidal wave may be, at depth where processes of formation of spots are formed, its disturbances will be insignificant. No any tidal action exposure and even any gravitational disturbance from any planet in the

Solar System will appear and penetrate into such depths. Nevertheless, results of [Pudovkin, *et al*. 1977] showed experimentally that there was a fact of external influence on the SA, somehow connected with the planets.

METHODOLOGY AND MAIN FINDINGS

In this work it is suggested to choose the Jupiter and Mars planets differing considerably from each other. Further, we will apply a completely new technique for research of the SA. Namely, we will “make" two huge “measuring devices» out the Jupiter and Mars planets in the solar system representing the Jupiter-Earth-Sun, Mars-Earth-Sun systems in which the Earth will be a “registering apparatus”. In this case the temporal « registration scale» of measured effects will begin from the moment of oppositions of the Earth-Jupiter and the Earth-Mars. Further, for the analysis we will use three groups of parameters. The solar data will be the first group of parameters, namely, a temporal change of density, temperature and velocity of the solar wind. The change of these solar parameters characterizes a state of interplanetary environment by longitudes round the Sun in connection with the exposure of the Jupiter and Mars on the SA. The second group of parameters are the main meteoparameters of central regions of Yakutia i.e. results of continuous measurements of temperature and precipitations for the period of more than 100 years. The choice of region is caused by the stable weather in this region during long time intervals (decades), absence of storm manifestations and other sudden changes.

The third parameter is the Wolf numbers characterizing a disturbance of internal regions connected with a spot-formation. Such choice of parameters is caused by the fact that if responses in a form of synodic periods of the Jupiter and Mars will be manifested in them, then in the all rest geo-heliophysical parameters the effects from their influence will be manifested without fail. Manifestations of influence of the Jupiter and Mars in the solar and meteorological parameters have been studied using a superposed epoch technique. For this purpose we preliminary process an experimental set of solar data by a strip probabilistic filtration, i.e. we take a probabilistic trend with an averaging period of 1000 days (with a parameter of probabilistic averaging σ = 250 days) and we subtract it from a primary number of solar data (density, temperature and velocity of the solar wind).

After such operation we obtain numbers in which there won’t be variations with the periods of more than 1000 days. Further from these new numbers we take a probabilistic trend with the averaging period of 100 days (with the parameter of probabilistic averaging σ = 25 days). As a result we obtain numbers in which there will be no variations with the periods of less than 100 and more than 1000 days (the strip filtration with a "strip" by periods from 100 up to1000 days is realized). After that, in such numbers (in the density, temperature and velocity of the solar wind since July 26, 1965 taken from the Internet) we will use a superposed epoch technique. Further, it is almost impossible to find the dates of oppositions of the Jupiter-Earth and the Mars-Earth (repper superposition points) or, for example, for the Wolf's numbers for the January 1,1818 to November, 29th, 2005 period in the literature , nevertheless, there is a possibility to simplify this problem. We proceed as follows: in any calendar or in an astronomical directory we find, at least, if only one date of the Jupiter -Earth opposition.

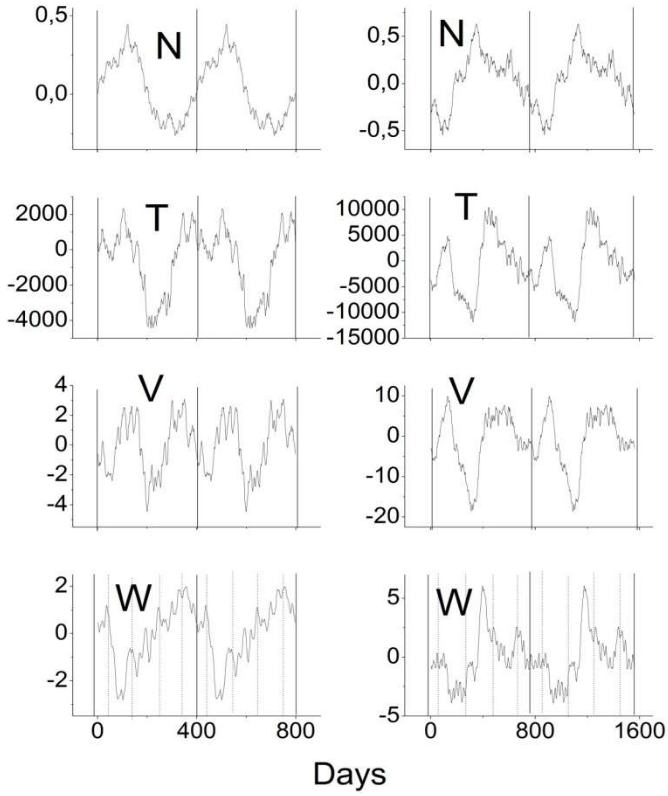

Fig. 1. Results of a superposition of solar parameters of density (N), temperature (T), velocity (V) of the solar wind for the periods of 399 days (left panel) and 780 days (right panel). On the lower panel there is a superposition of Wolf (W) numbers. For comparison and presentation it is shown by two periods

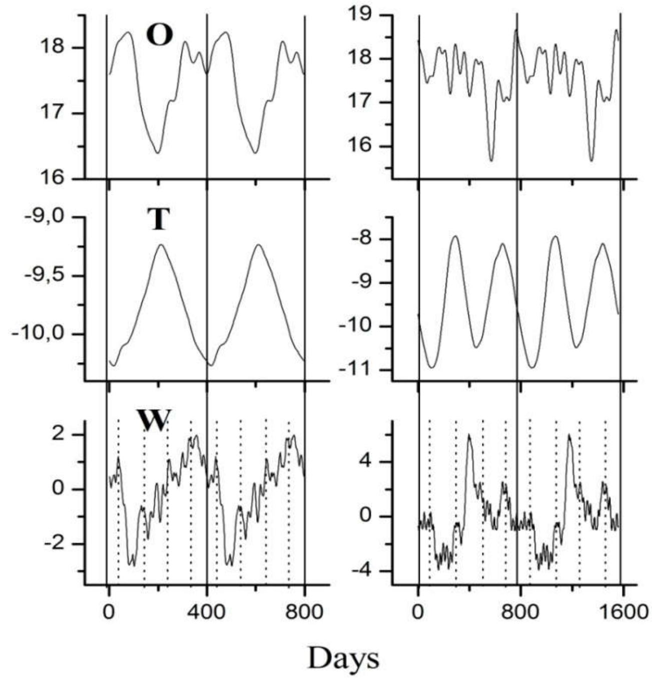

Fig. 2. Results of a superposition of the following meteoparameters: precipitation (O), temperatures (T) in of Yakutsk for the January1, 1888 to December 31, 1995 periods of 399 days (left panel) and 780 days (right panel). The lower plots show results of superpositions of the Wolf numbers (W). It is shown by two superposition periods

For example, in a print edition [Astronomical Annual Book of the USSR, 1980] we find the date of such opposition on February 25, 1980. (From Table of geocentric distances.)

Before this date from January 1, 1818 it will be the 59224 day. We divide this number into 399 up to the whole number. We will obtain the remainder of 173 days. It will be the first point (phase) of the beginning of superposition operation sequentially for the period of 399 days. The same simple operation is also carried out with the period of the Mars-Earth opposition by all parameters. Such method has been used for a treatment of the whole set of experimental data. Results of the solar parameter and meteoparameter treatment are shown in Fig. 1 and Fig. 2. respectively. The left panels are the results of superposition on the synodic period of the Jupiter. The right panels are the results on the synodic period of the Mars.

Let's consider at first the upper panels - the influence of the Jupiter and Mars on the solar wind density (N). (see Fig. 2) .The upper left panel shows that the effect, in the density of the solar wind accounts for the maximum value (amplitude) of 0.47 cm-^{3}. On the right panel the same effect from Mars is equal to 0.64 cm^{-3}. At average density of the solar wind particles of 7.5 cm^{-3} these effects account for 6.27 % and 8.53 %, respectively. For density of 0.47см$^{-3}$ the following question arises: whoseparticlesare these? Jovian or solar ones? It is known that the Jupiter can inject a considerable quantity of high- energy charged particles. Assume that the change of density with the amplitudes of 0.47 cm^{-3} near to the Earth' vicinity form low-energy particles which have come from the Jupiter. Then, taking into account a square of distance of 4.2 a.u. this density near to the Jupiter beyondits magnetosphere should equalto≈ 8.3 cm^{-3}. Direct measurements of particle density aboard space vehicles near to the Jupiter [Teegarden B.J. et. al., 1974] givethe value of this density of only 0.3 cm^{-3} that accounts fora lesservalue by a factor of≈ 28 . i.e. a considerable quantity of low-energy particles, at least, towards the Sun.The Jupiter injects particles much less by a factor of ≈ 8 - 16. Thus, the Jupiter and Mars change a concentration of solar wind particles of 0.47 and 0.64 cm^{-3}, respectively, at the expense of focusing and further absorption of these particles. Taking into account the average value of density of 7.5 cm^{-3}, such changes in percentage constitute values of 6.27 % and 8.53 %. These are only amplitudes (fluctuations near a background), and the complete changes over a background will be twice as much as 12.5 % and 17 %.These are very great effects, for example, in comparison with the average Forbush-effect in cosmic rays.The effects of changes of temperature (T) and velocity (V)of the solar wind in such process constitute 2270^0 K and 3.17 km/s due to the exposure ofthe Jupiter, and 10409 ^{0}K and 10 km/sdue to the exposure of Mars .The average values of temperature and velocity of the solar wind are equal to 1.15×10^{50}K and 446 km/s.

The values of effects in following percentage:1.97 %, 0.71 % and 9.05 %, 2.42 % correspond to them , respectively. As is seen, if the effects from the influence on the SA of the Jupiter and Mars are comparable in the density , then the effects in the temperature and velocity from the Mars are greater by a factor of several times. The explanation of effects of the influence of the Jupiter and Mars in meteorological parameters is the following. The increase of solar spots leads to transformation of a solar radiant spectrum. In this case a total energy, as the experiment shows (the solar constant outside of the atmosphere) ,does not almost change .Simply there occurs the extension of share of the short-wave radiation. The short-wave radiation is effectively reflected and absorbed by the upper Earth's atmosphere. As a result, thermal insolation of the Earth 's surface decreases that leads to the decrease of the ground temperature. It is brightly shown on the middle plot of the left panel in Fig. 2. The decrease of temperature leads to the intensification of water vapor condensation processes and subsequently there occurs the increase of precipitations (see Fig. 2). Naturally, all processes are manifested with some delay untill the average balance of water vapor in the Earth's atmosphere establishes (injection by water vapor oceans and stirring of it by air masses). By results of the left panel (see the middle plot) this delay is ≈ 73 - 110 days. The noticeable value of effect owing to the influence of the Jupiter and Mars on the main meteoparameters of the central Yakutia is shown. By temperature and precipitation the effect accounts for the value of fluctuations from the average (average temperatures and are 9.8^{o}C and 17.5) values (10.2 - 15.3) % and (5.7 - 8.5) % , respectively. In brackets the first values relate to the Jupiter and the second ones - to the Mars.

MANIFESTATION OF SYNODIC PERIODS OF THE JUPITER AND MARS IN THE SPECTRUM OF THE WOLF'S NUMBERS

There is one more vivid example of the influence of the Jupiter and Mars on the SA. It is manifested in the power spectrum density obtained from the Wolf's numbers (Fig. 3). It is seen that "the peaks" corresponding to the periods of 399 and 780 days in the interval of 20 - 1000 days, are the greatest. They are more by a factor of almost twice than 27-day variations, i.e. effects from the influence of the Jupiter and Mars are the greatest, in comparison from the influence of other planets, for example, the Mercury(Fig. 3 , see the dotted line near 88 days . 88 days are the sidereal period of the Mercury).

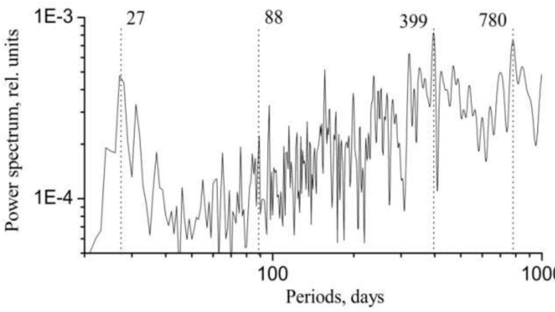

Fig. 3. Power spectrum as a function of periods calculated by the Wolf's numbers. It is brightly seen that the "peaks" corresponding to the periods of 399 and 780 days are almost twice as high as 27-day variations

In this case it is necessary to take into consideration that variations the 27-day variations in the spectrum of any geo-heliophysical parameters are an authentic event taking into account estimations according to the law of probability with the account of strict coincidence with astronomical periods, and also with all other independent effects in geo-heliophysical parameters. Whence the 399 and 780-day peaks will almost correspond to the authentic events because they are twice as high as the 27-day variations and also are manifested in many geo-heliophysical parameters. Thus, the availability of influence of synodical periods of the Jupiter and Mars on space weather parameters is shown.

Conclusion

The influence of the Jupiter and Mars, differing considerably from each other, on the solar activity is investigated. It is shown that they change the concentration of solar wind particles by 6.27 and 8.53 percent, respectively. Average values of effects in the temperature and solar wind speed in percentage are 1.97, 0.71 and 9.05, 2.42, respectively. The power spectrums as a function of periods with respect to the Wolf's numbers show the noticeable effects corresponding to the periods of 399 and 780 days, which were considerably greater of 27 variations. The analysis of data on the temperature and precipitation has revealed that their oscillations differ from the average values by (10.2-15.30) and (5.7-8.5)

Acknowledgment

The work was financially supported by the Russian Fund for Basic Research (the project № 01- 02-17278, the project № 01-02-96206, the project №09-02-98507)

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Editors: Billy M. McCormac, Thomas A. Seliga P.175-179

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